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This document is focused on describing how, technically, implementing adaptive technology and supplemental curriculum for Anatomy and Physiology is developed from a functional use aspect including Functionality Use Case Scenarios, Technical Architecture Overview, Medsn Learning Object (MLO) Details, E-Learning Path (ELP) Details and SCORM Implementation.

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Item No: 0001AK

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Implementing Adaptive Technology and Supplemental Curriculum for Anatomy and Physiology

Contract #: USZA-22-01-C-0024

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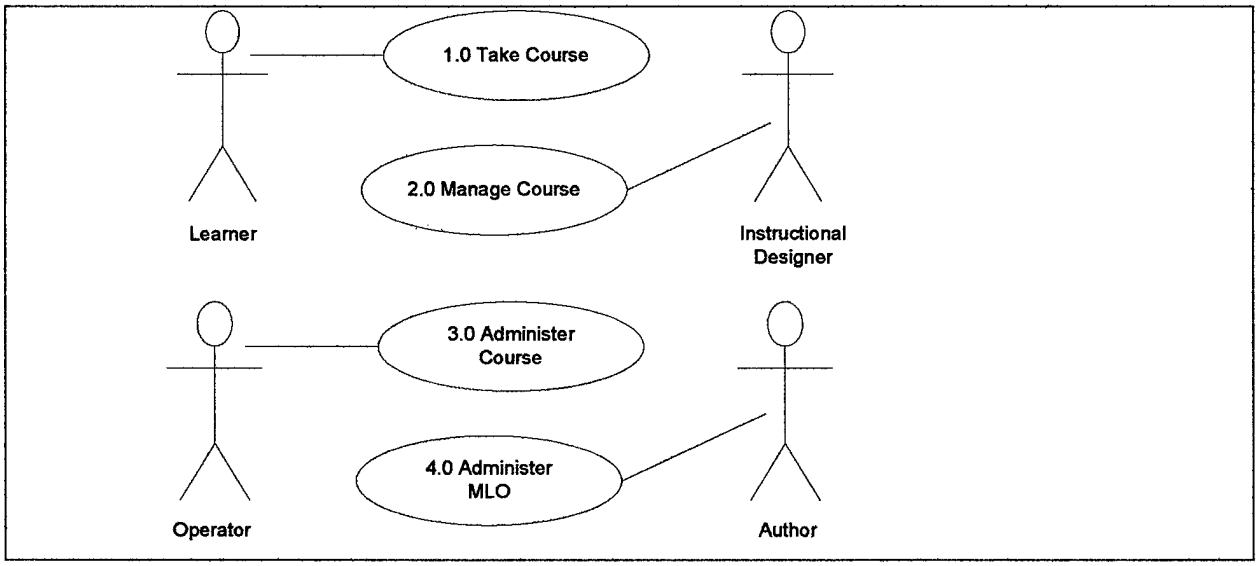
Functionality Use Case Scenarios

Summary:	Covering the scenario of the learner negotiating the system to take an adaptive e-learning SCO (sharable content object).
Functionality:	This covers the area of a learner taking a SCO which includes: - The visual display of a SCO described by an e-learning path (ELP). - The personalization of an e-learning path through adaptiveness. - The launch of a pre-assessment test via an ELP. - Recording of a learner's pre-assessment information via the LAP record. - The launch of a module via an ELP. - The launch of a post-test via an ELP.
Assumptions:	All elements that have add or create functionality can be assumed to have an edit that gives access to the same data fields.
Non-Goals:	This set of use case scenarios does not define the general case for a learner.

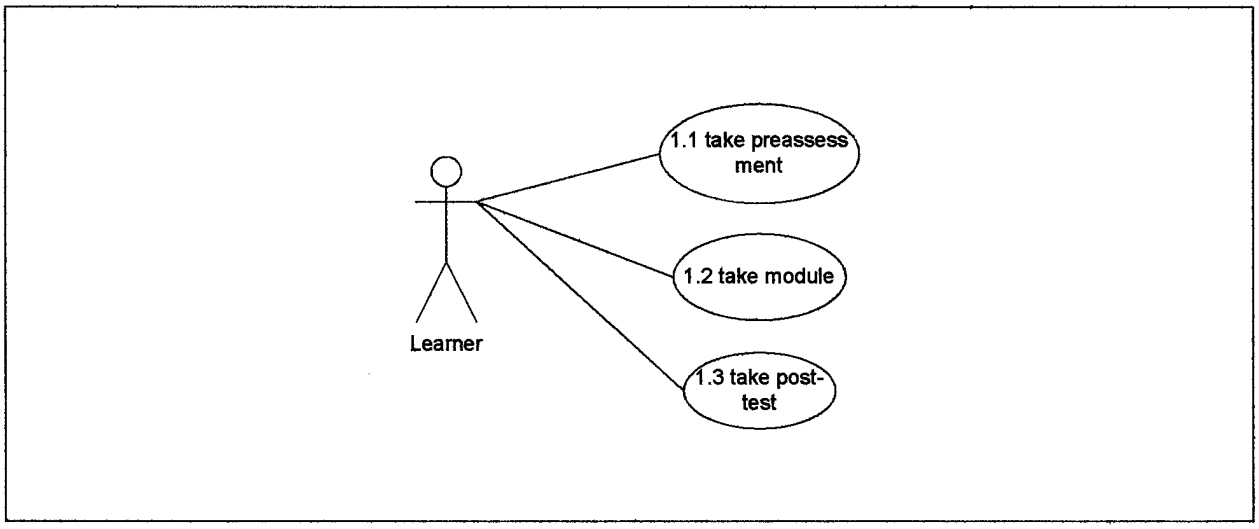
Diagram Element Description

Element:	**Description:**
Take SCO	High-level use case of system involving learner whose purpose for using the system is to take a SCO.
Manage SCO	High-level use case of instructional designer interacting with the system to identify and manage SCOs for learners to take.
Administer LAP	High-level use case of a Medsn operations staff who interact with the system to administer the LAP record.
Administer MLO	High-level use case of a content author interacting with the system to administer information about Medsn Learning Objects.

High Level System Diagram



Detailed System Diagram



Use Case Scenario: Take Pre-assessment

USE CASE #	Take Pre-assessment	
Goal in Context		
Scope & Level	Primary Task	
Preconditions	Learner is logged into the application and has at least one SCO available for taking. *Also, the SCO selected is an adaptive SCO.*	
Success End Condition	Completed pre-assessment test and updated LAP record.	
Failed End Condition	Incomplete pre-assessment test and LAP record not recorded.	
Primary, Secondary Actors	Learner	
Trigger	Learner selects the *SCO* gateway page link.	
DESCRIPTION	**Step**	**Action**
	1	Learner selects *SCO* gateway page link. The system determines the status of the learner's ELP according to the information in the LAP record. The ELP is displayed on the *SCO* gateway page.
	2	Learner selects the pre-assessment test link. The system displays the appropriate pre-assessment test in a separate window.
	3	Learner answers the pre-assessment questions. The system stores the answers to the pre-assessment questions in the question metrics.
	4	Learner completes the quiz by answering the final quiz question. The system displays the learner's score on the pre-assessment test. The pre-assessment question results are stored in the LAP record. The system also calculates the learner's ELP from the results of the pre-assessment test.
	5	Learner exits the quiz by closing the quiz window. The system determines the status of the learner's ELP according the information in the LAP record. The new ELP is displayed on the SCO gateway page.
EXTENSIONS	**Step**	**Branching Action**
	4a	Learner does not answer the final quiz question: 4a1. Discard pre-assessment results
SUB-VARIATIONS		

Use Case Related Information

RELATED INFORMATION	Take Pre-assessment.
Priority:	High
Channels to actors	Interactive
Superordinates	1.0 Take SCO.
Subordinates	

Use Case Scenario: Launch MLO

USE CASE #	Launch MLO	
Goal in Context		
Scope & Level		
Preconditions	ELP exists with at least one learning node available for viewing.	
Success End Condition	Learner has viewed module and LAP record is updated with module information and revised ELP is calculated.	
Failed End Condition	Learner has not viewed module and LAP record is not updated and ELP is not recalculated.	
Primary, Secondary Actors	Learner	
Trigger	Learner selects MLO node.	
DESCRIPTION	**Step**	**Action**
	1	Learner selects SCO gateway page link. The system determines the status of the learner's ELP according to the information in the LAP record.
	2	Learner clicks on learning node to launch. The MLO launches in a separate window. The system issues a SCORM initialize command upon SCO execution.
	3	Learner exits MLO by closing the module window. The system issues a SCORM finalize command to signify MLO completion. The system recalculates the learner's ELP according to the information in the LAP record. The revised ELP is displayed on the SCO gateway page.
EXTENSIONS	**Step**	**Branching Action**
	1a	Learner selects SCO gateway page link. 1a1. The system creates a default LAP record for the learner if this is the first time accessing this ELP.

SUB-VARIATIONS		Branching Action
	1	

Use Case Related Information

RELATED INFORMATION	Launch MLO
Priority:	High
Performance	
Frequency	High
Channels to actors	Interactive
Superordinates	1.0 Take SCO
Subordinates	

Use Case Scenario: Take Post-test

USE CASE #	Take Post-test	
Preconditions	ELP in which the predecessor learning nodes have been successfully completed.	
Success End Condition		
Failed End Condition		
Primary, Secondary Actors	Learner	
Trigger	Learner selects post-test learning node.	
DESCRIPTION	**Step**	**Action**
	1	Learner selects SCO gateway page link. The system determines the status of the learner's ELP according to the information in the LAP record. The ELP is displayed on the SCO gateway page.
	2	Learner selects the post-test learning node link. The system displays the appropriate post-test in a separate window.
	3	Learner answers the post-test questions. The system stores the answers to the post-test questions in the question metrics.
	4	Learner completes the quiz by answering the final quiz question and achieves a passing score. The system displays the learner's score on the post-test. The post-test is identified as complete and passed in the LAP record.

	5	Learner exits the post-test by closing the test window. The system recalculates the learner's ELP according to the information in the LAP record. The revised ELP is displayed on the SCO gateway page.
EXTENSIONS	**Step**	**Branching Action**
	4a	Learner completes the quiz by answering the final quiz question and does not achieve a passing score. 4a1. The system displays the learner's score on the post-test. The post-test is identified as complete and not passed in the LAP record.
SUB-VARIATIONS		**Branching Action**
	1	

Use Case Related Information

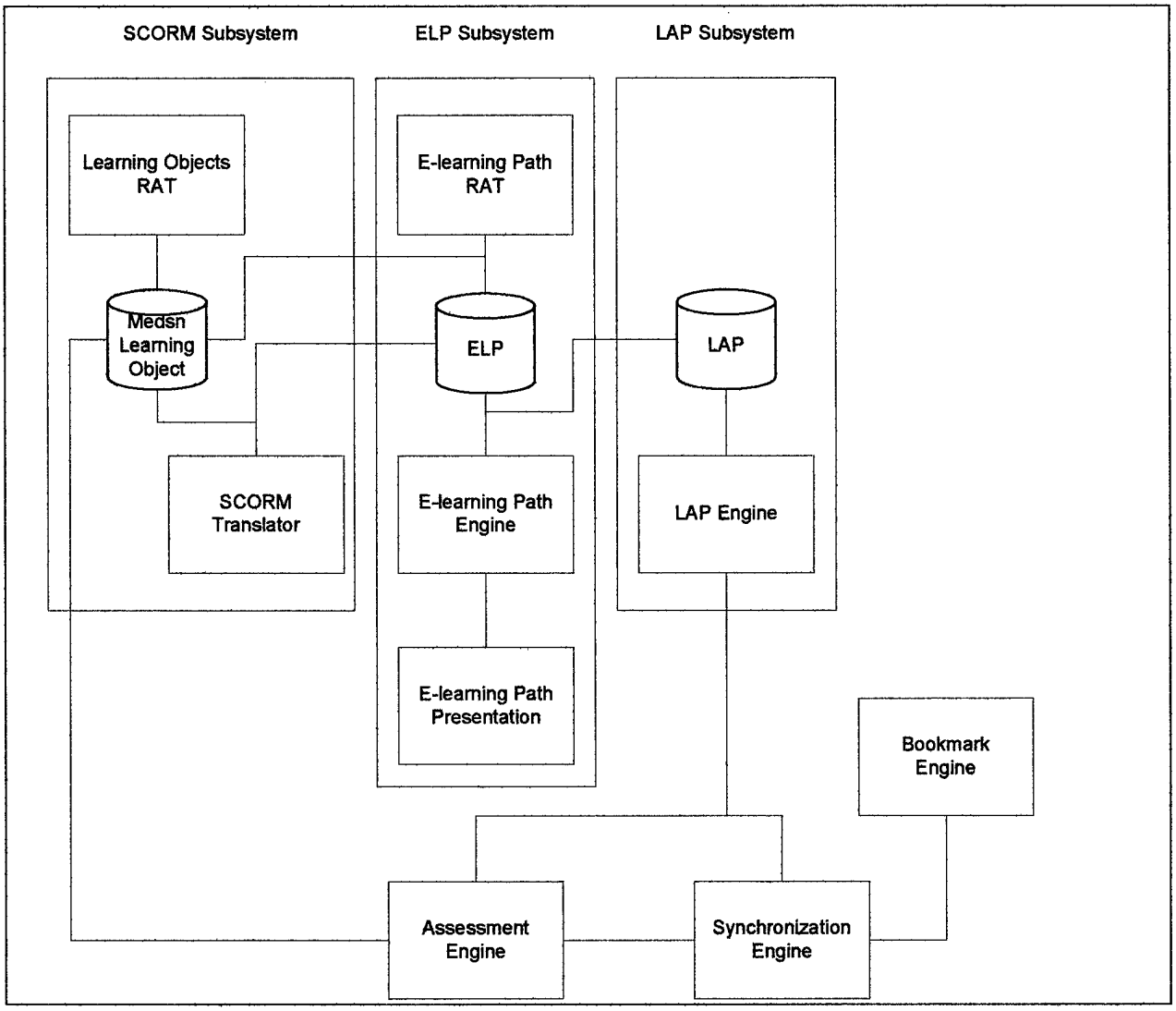
RELATED INFORMATION	Take post-test
Priority:	High
Performance	
Frequency	Medium
Channels to actors	Interactive
Superordinates	1.0 Take SCO
Subordinates	

Technical Architecture Overview

Architecture Overview – Overall System

Description, purpose, objectives	The purpose of this system is to deploy an architecture for supporting the delivery of the DoD content. This platform will allow for personalized presentation of courses via a pre-assessment test. An additional purpose is to conform to DoD guidelines and extend Synopsis to be SCORM-compliant.
Use Cases Included	
Features covered	Adaptiveness Level 1 (inter-learning object) SCORM run-time functions (start and finish) SCORM content packaging specification SCORM metadata E-learning path Implementation of the Learner Activity Profile
Exclusions	SCORM run-time functions outside of start and finish. Intra-learning object adaptiveness. Bookmarking and annotations.
Dependencies	None
Additional comments	

Component Diagram – *Describe the components involved in the system.*



Interfaces Between Components – *Describe how the components in the system interact.*

Component Component Interface
Learning Object Remote Authoring Tool (RAT) Medsn Learning Object (MLO) JDBC

SCORM Translator
E-learning Path (ELP)
JDBC

SCORM Translator
Content Specification Package
XML

ELP RAT
ELP
JDBC

ELP RAT
MLO
JDBC

ELP Engine
ELP
JDBC

ELP Engine
LAP
JDBC

ELP Engine
ELP Presentation Engine
HTTP/JSP

LAP Engine
LAP
JDBC

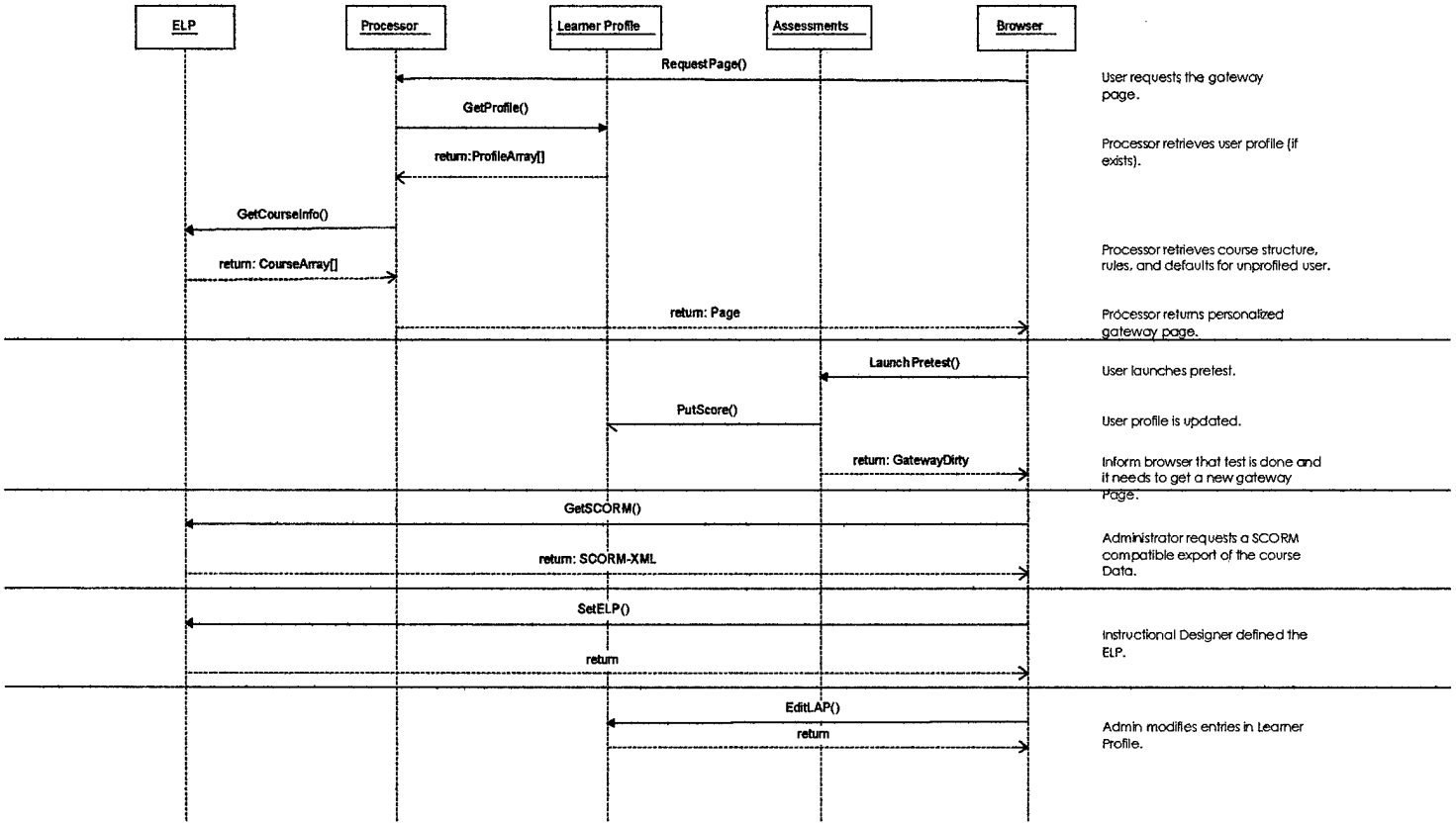
Assessment Engine
LAP Engine
HTTP

Synchronization Engine
LAP Engine
JavaScript

Assessment Engine
MLO

JDBC

Control Flow Diagram - *Complete this section to show the control flow and the data flow of the key components or objects of the architecture (more legible when printed).*



The following 2 figures illustrate the logical structure of the system. Figure 1 describes the domain object model of the various components of the system from a logical perspective. Figure 2 illustrates the database schema that was created to implement the components and sub-components of the platform.

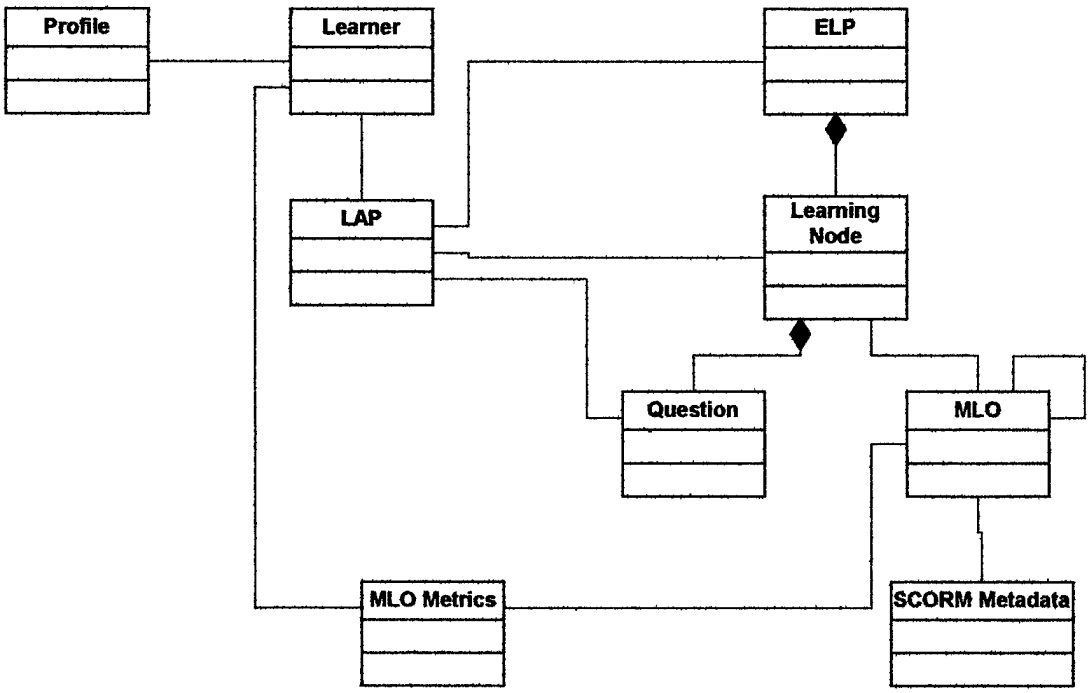


Figure 1 - Domain Object Model.

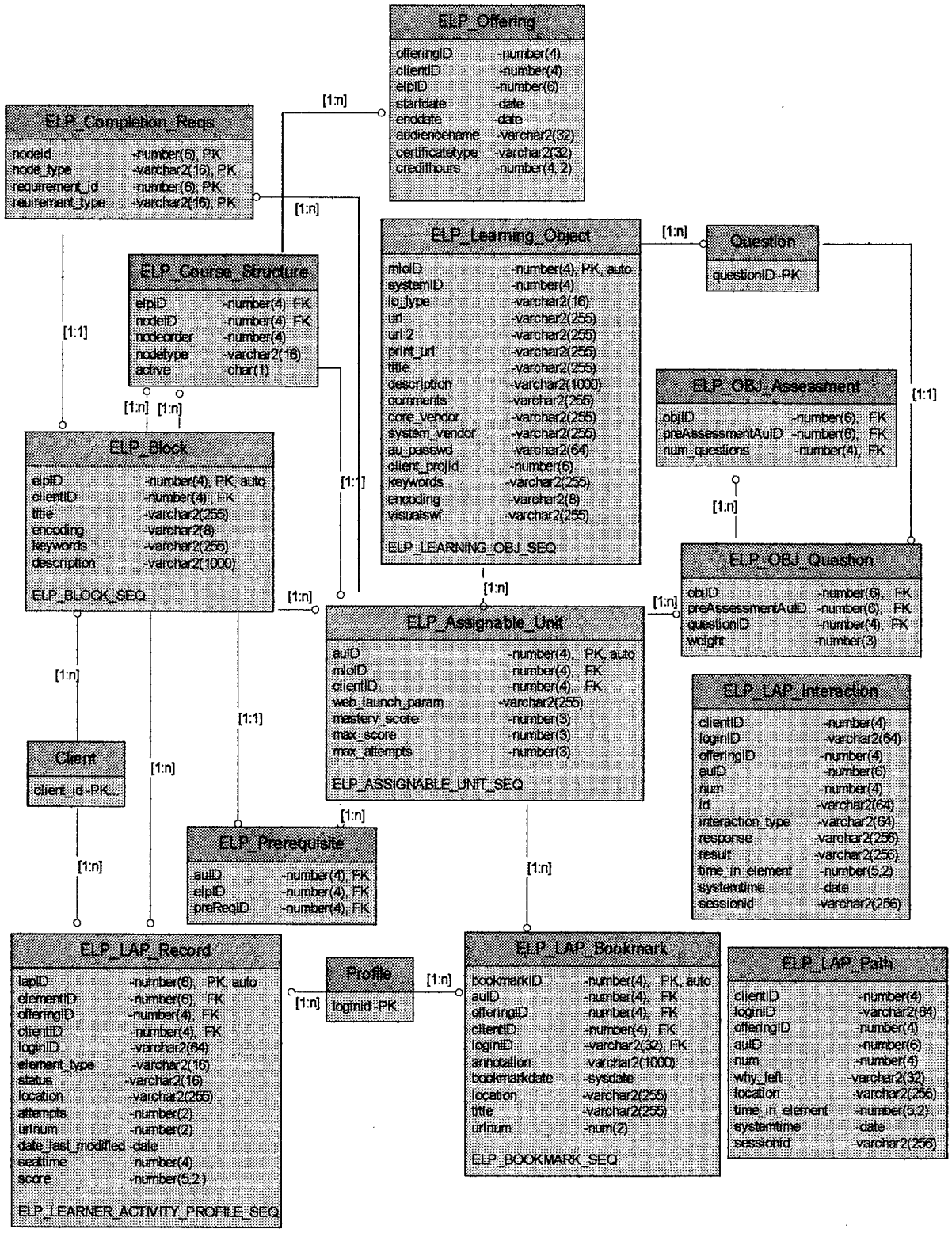


Figure 2. Database Schema.

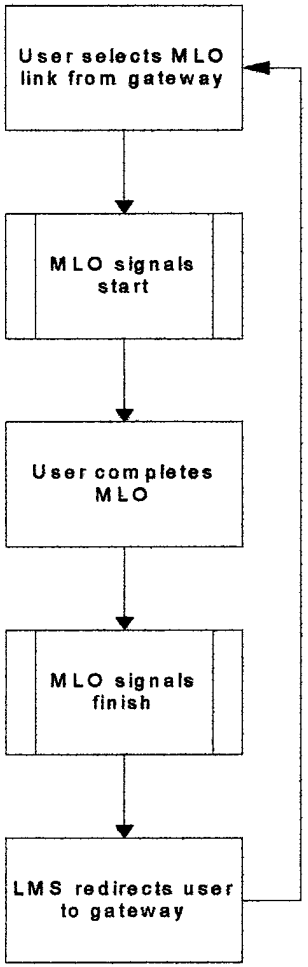
Medsn Learning Object (MLO) Details

Architecture Overview

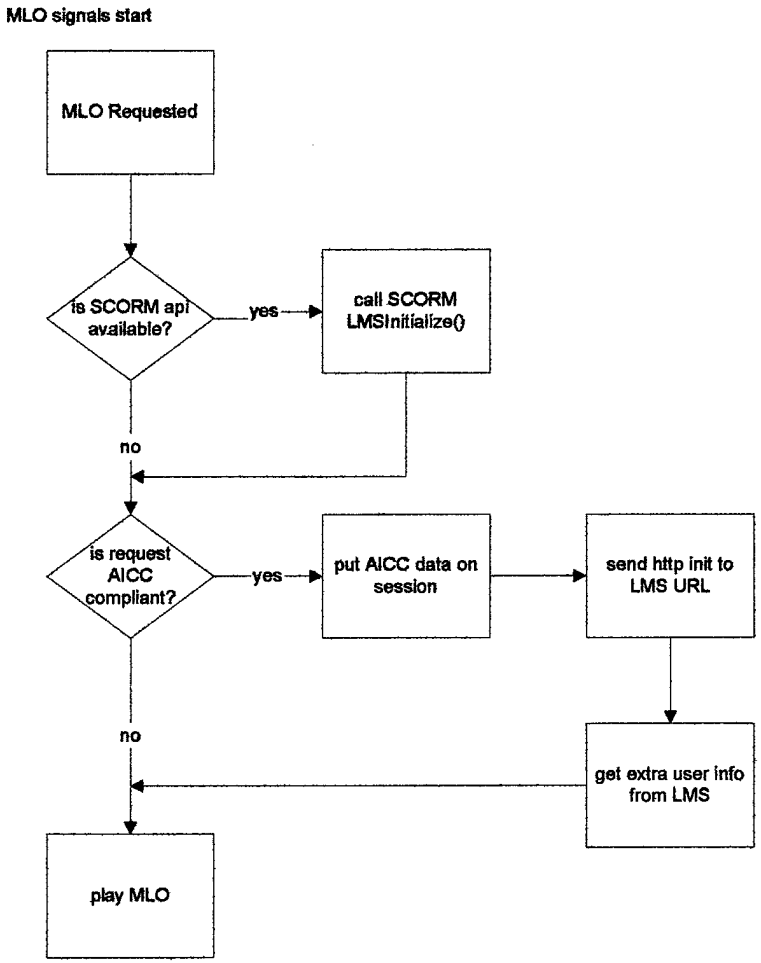
Description, purpose, objectives	Covers standard's requirements for running MLOs including SCORM and AICC run-time environments when launched by an LMS. Also defines a Medsn LMS implementation.
Use Cases Included	User starts MLO User finishes MLO
Dependencies	
Additional comments	The Medsn LMS implementation defined here follows AICC run-time and communication standards.

Logical Architecture Block Diagram – *Describe the logical functional diagram of the architecture.*

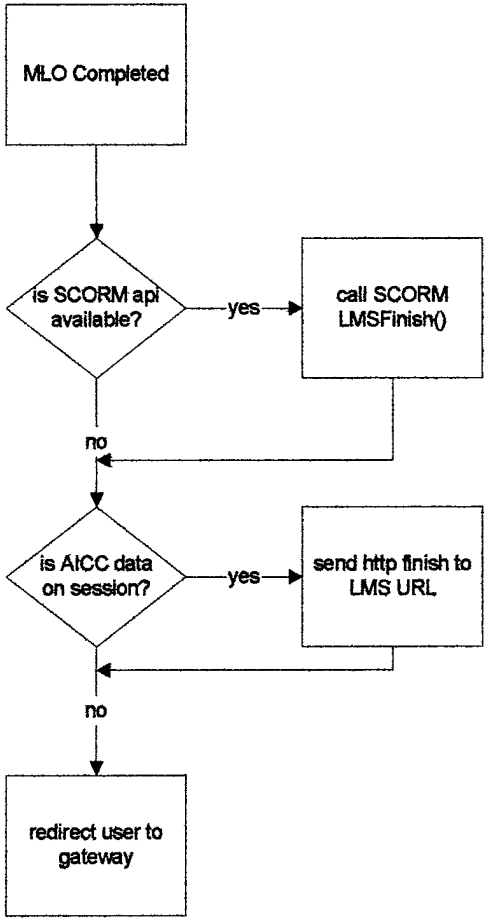
High-level Flow



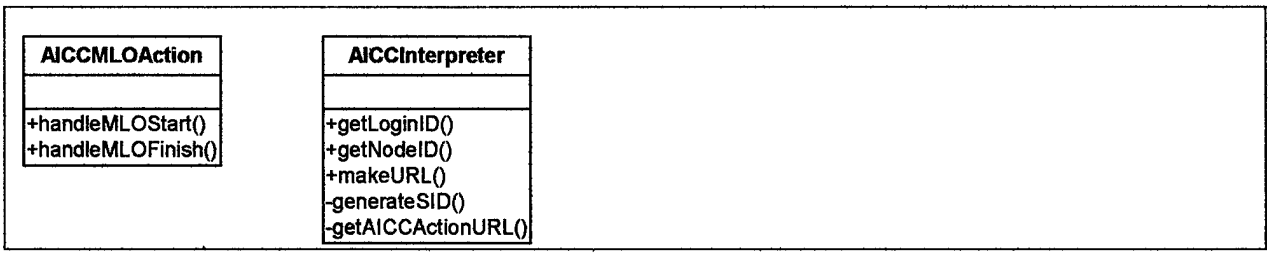
MLO Signals Start



MLO Signals Finish



Class Diagram – *Describe all objects of the software architecture.*

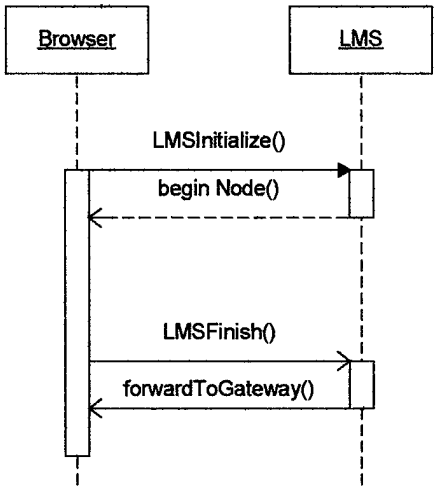


Control Flow Diagram - *Complete this section to show the control flow and the data flow of the key components or objects of the architecture.*

SCORM Run-time

User begins a course node. LMS is notified by the node.

User ends course node. LMS is notified by the node. User is forwarded to gateway page.



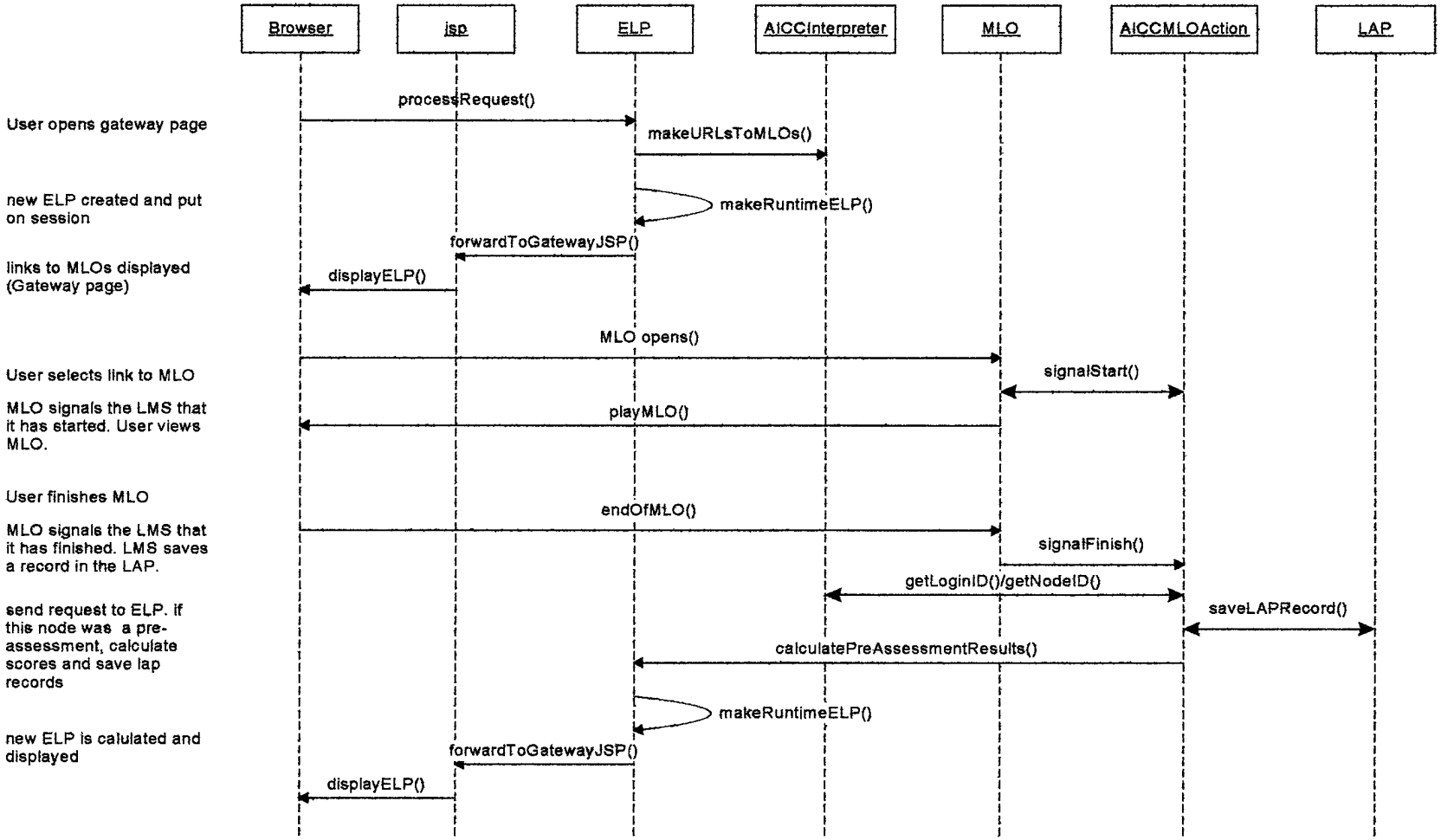


Figure 3. Run-time Sequence Diagram.

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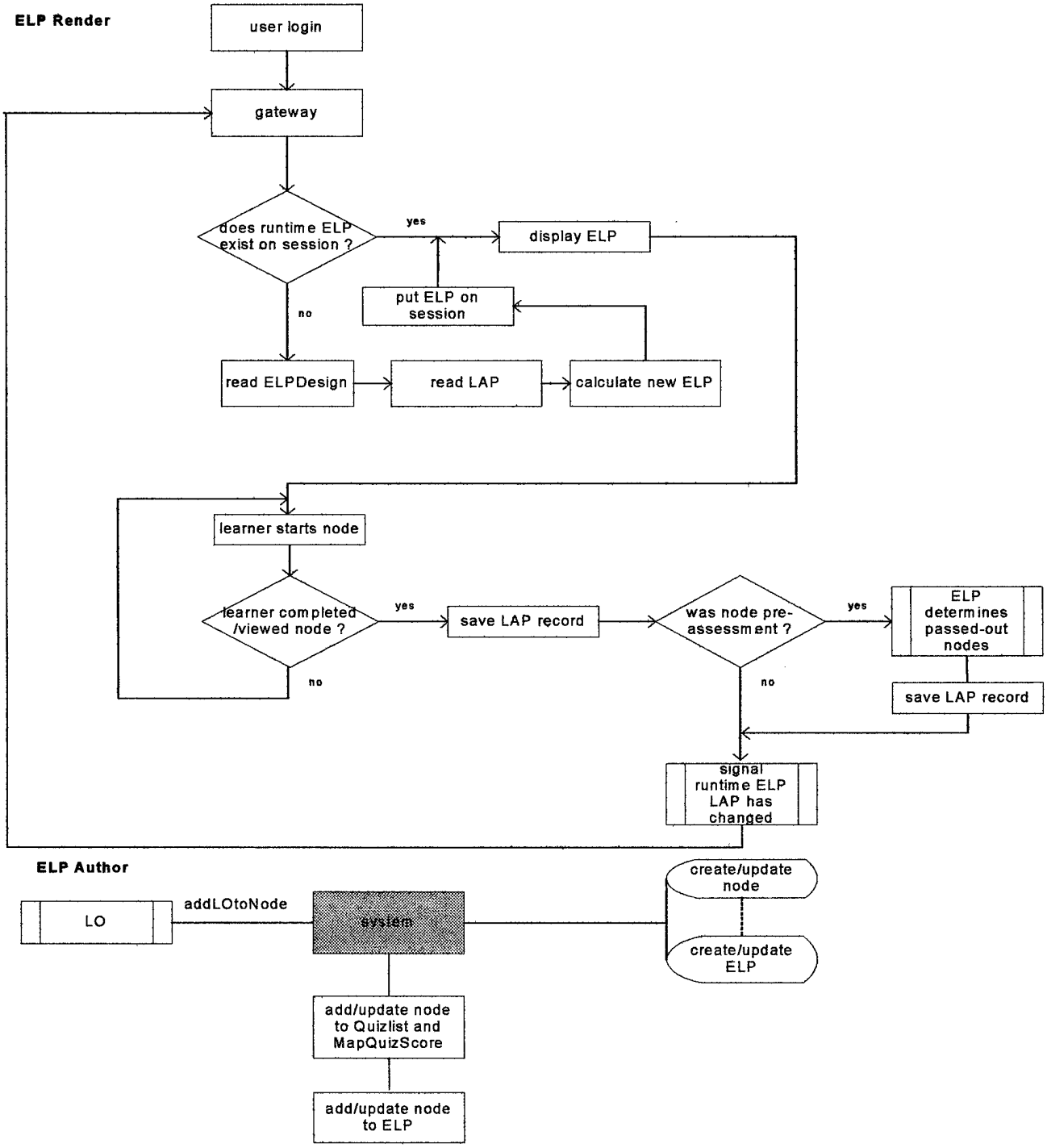
E-Learning Path (ELP) Details

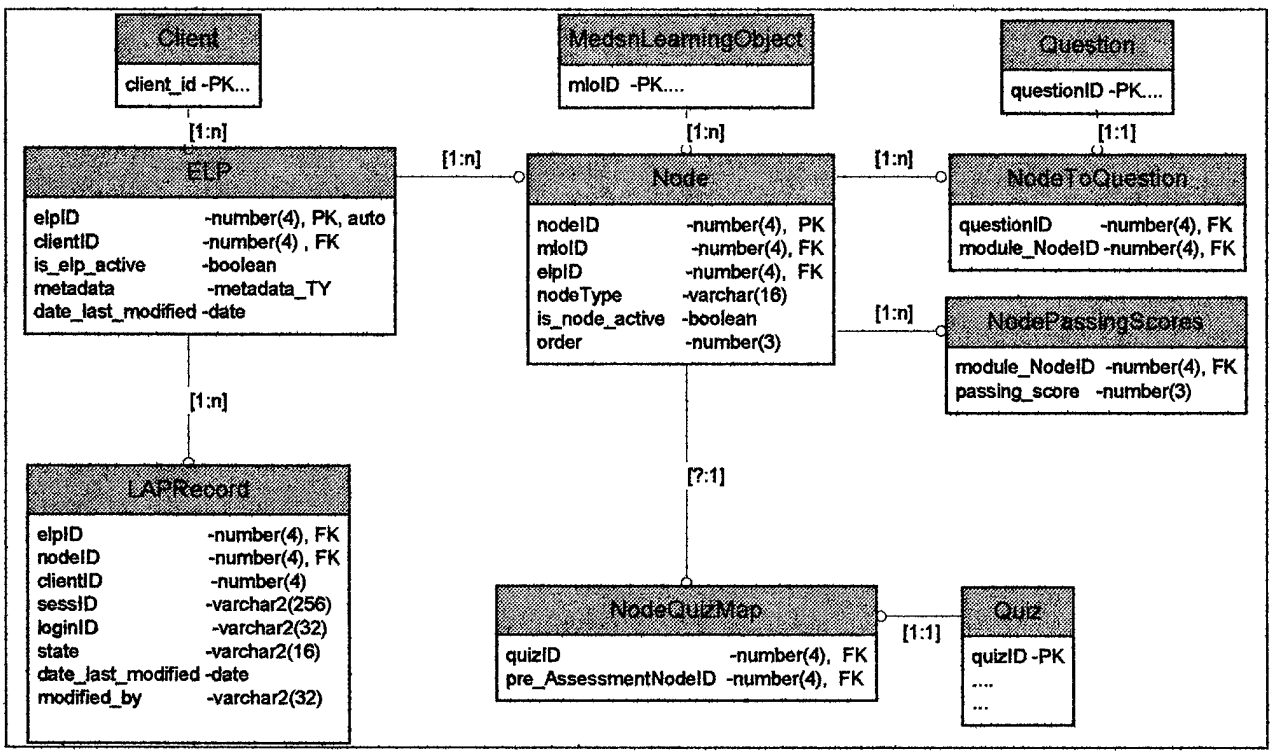
Architecture Overview

Description, purpose, objectives	**ELP Author:** The components design in creation of a course via an e-learning path, editing of a course and exporting of a course to a SCORM content package. The instructional designer will use this tool to: **ELP Render:** The components design for defining the adaptive behavior of the ELP. - The visual display of a course described by an ELP - The personalization of an ELP through adaptiveness. - The launch of a pre-assessment test via an ELP. - Recording of a learner's pre-assessment information via the LAP record. - The launch of a module via an ELP. - The launch of a post-test via an ELP.
Use Cases Included	**ELP Author:** -Define course structure -Assign LO to node -Export course **ELP Render:** -Take pre-assessment -Launch module -Take post-test
Dependencies	LO is a precondition for the course author/designer.

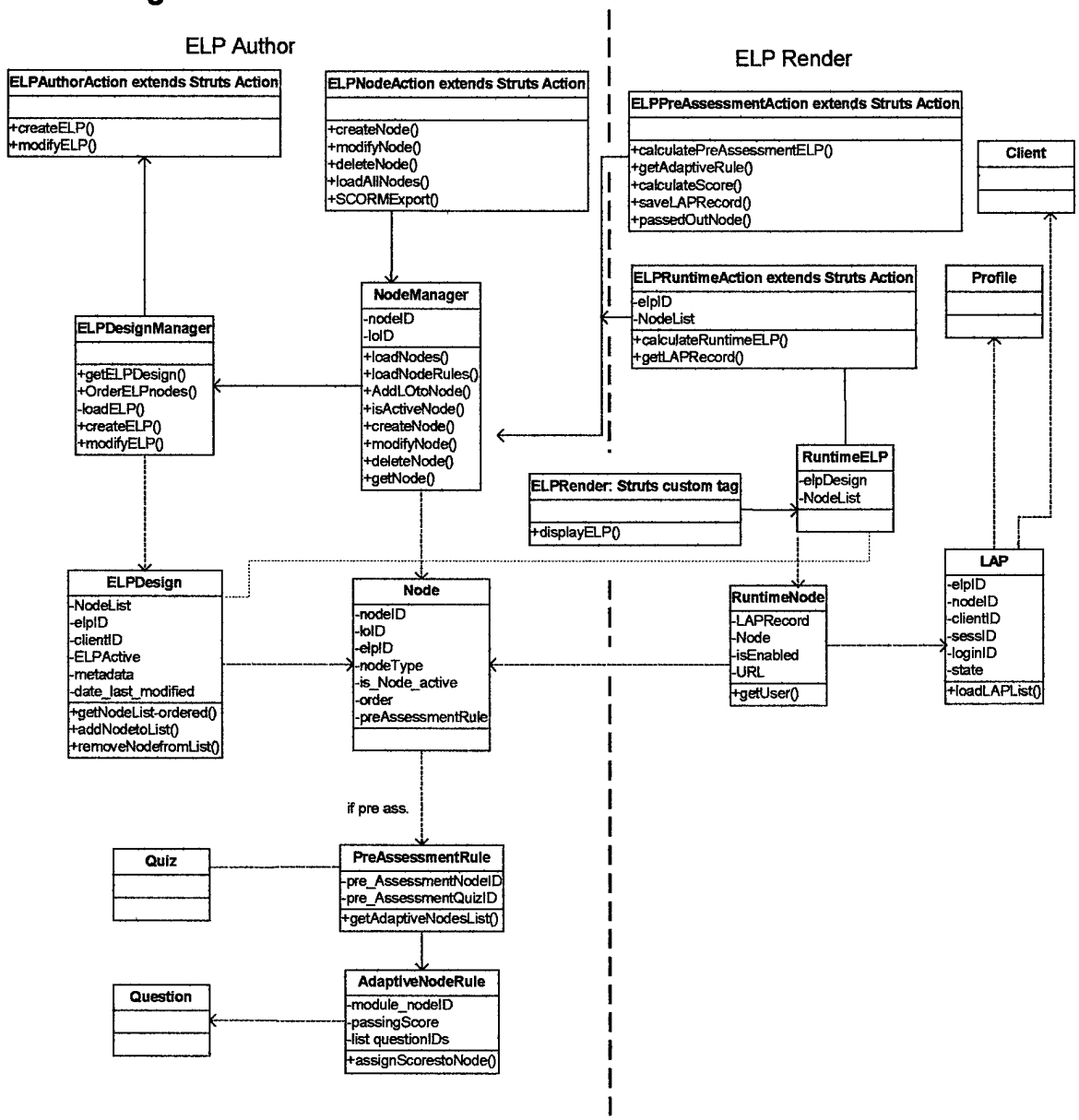
Logical Architecture Block Diagram



Entity-Relationship Diagram

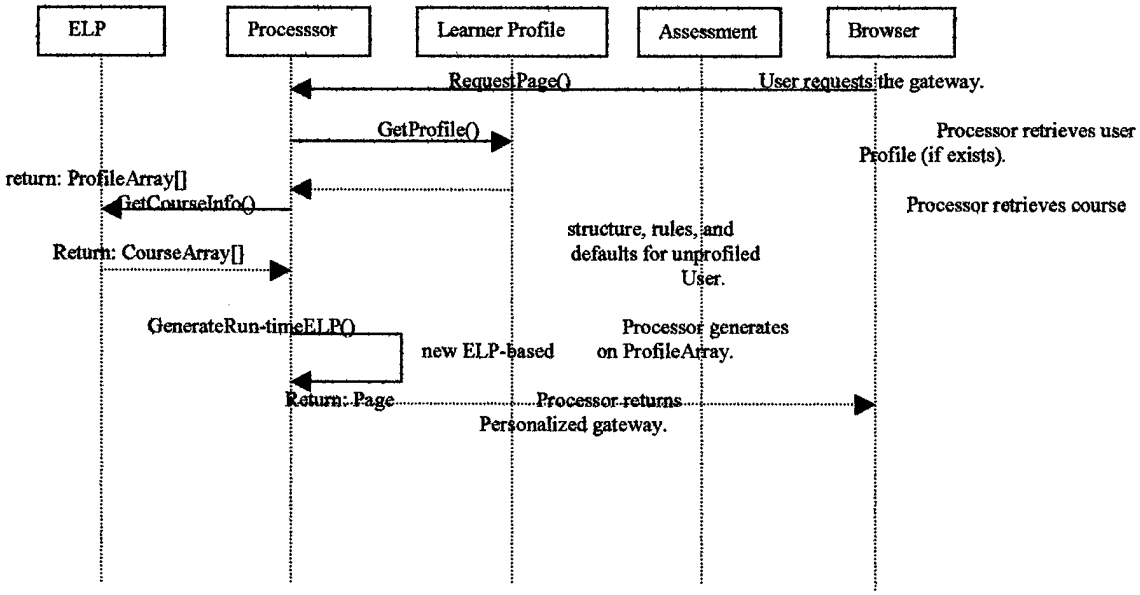


Class Diagram

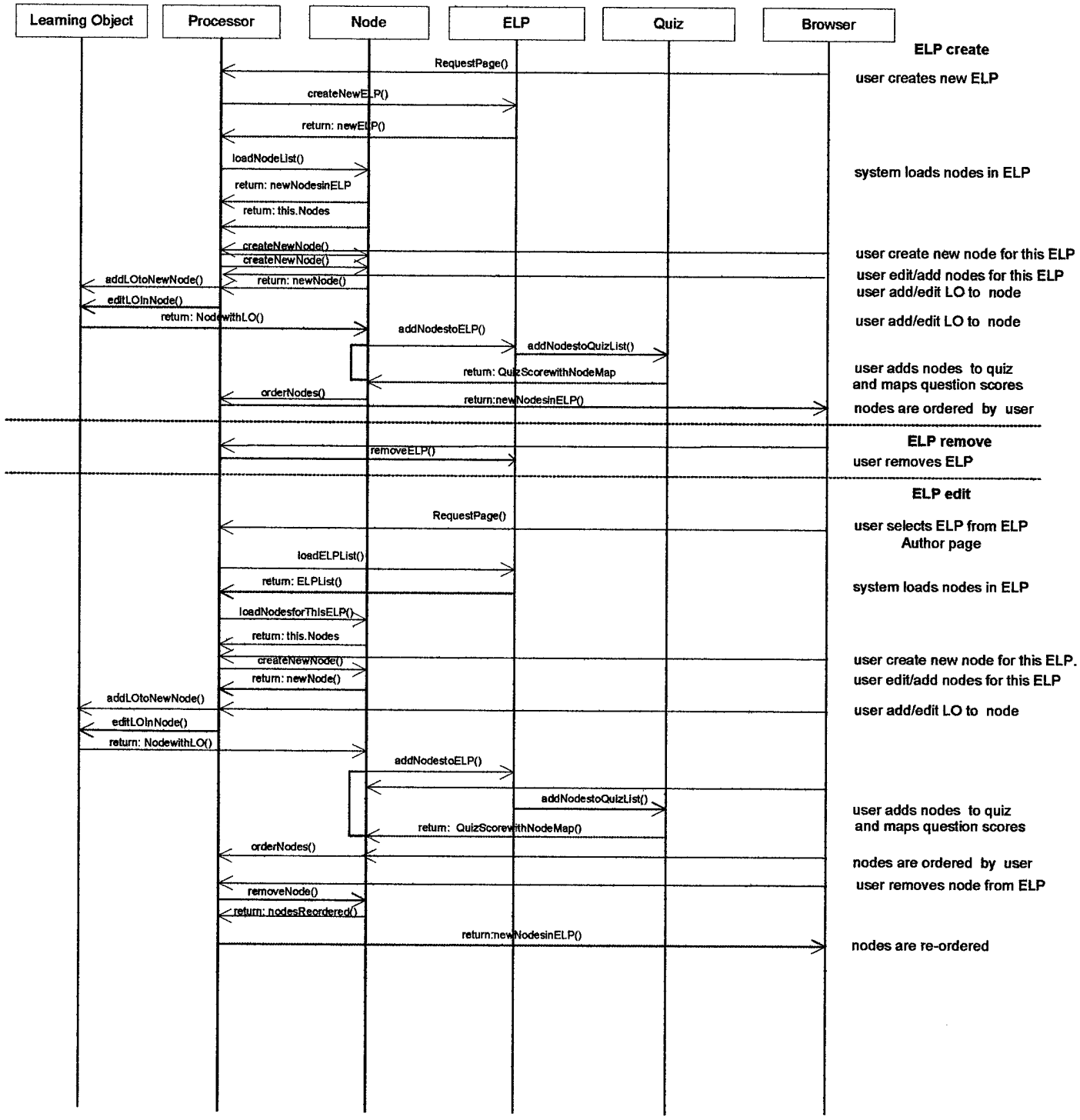


Control Flow Diagram

ELP Run-time



ELP Author


Learning Object
Processor
Node
ELP
Quiz
Browser
ELP create
RequestPage()
user creates new ELP
createNewELP()
return: newELP()
loadNodeList()
system loads nodes in ELP
return: newNodesinELP
return: this.Nodes
createNewNode()
user create new node for this ELP
createNewNode()
addLOtoNewNode()
return: newNode()
user edit/add nodes for this ELP
editLOInNode()
user add/edit LO to node
return: NodewithLO()
addNodestoELP()
user add/edit LO to node
addNodestoQuizList()
return: QuizScorewithNodeMap
user adds nodes to quiz
and maps question scores
orderNodes()
return:newNodesinELP()
nodes are ordered by user
ELP remove
removeELP()
user removes ELP
ELP edit
RequestPage()
user selects ELP from ELP
Author page
loadELPList()
return: ELPList()
system loads nodes in ELP
loadNodesforThisELP()
return: this.Nodes
createNewNode()
user create new node for this ELP.
return: newNode()
user edit/add nodes for this ELP
addLOtoNewNode()
user add/edit LO to node
editLOInNode()
return: NodewithLO()
addNodestoELP()
addNodestoQuizList()
user adds nodes to quiz
and maps question scores
return: QuizScorewithNodeMap()
orderNodes()
nodes are ordered by user
removeNode()
user removes node from ELP
return: nodesReordered()
return:newNodesinELP()
nodes are re-ordered

Public Interfaces

Learning Object:
SCORM content packaging modules;
LAP Author;
LAP metrics collection modules.

Private Interfaces

ELP Renderer
ELP Author

Algorithm Details

ELP Render

```
  userProfile(loginid, clientid);
 loadELP(this.user);
 take preAssessment();
 computeScore(score);
  if(this user passed) {
    recordLAP()
    markNodesPassed(nodesPassed);
    return nodesLeft();
  }
 else return originalELP();

loadELP(user){
 readLAPrecord for this user;
 if(LAPrecord exists)  markNodesPassedorViewed(nodesPassed);
 else return nodes from ELPNodesVector;

}

computeScore(this user score) {
 if(this user score >= baseScore) return passed;
 else return failed;
}

 markNodesPassedorViewed (nodesPassed){
 If (nodes in ELP contains(nodesPassed)) remove nodes from ELPNodesVector;
 return nodesLeft()
}

nodesLeft() {
 return remaining nodes from ELPNodesVector;
}
```

ELP Author

```
createELP() {
 loadNodes from node list;
 if( node on list) {
  add this node(s) to this ELP;
  orderNodes();
 } else {
  createNode();
  createELP();
 }
 return ELP;

}

editELP(){
 loadNodes from this ELP node list;
 selectNodestoEdit();
 case author choice of ELPeditActions
  case 1: addLOtoNode();
  case 2: changeLOinNode(nodeid, loid);
  case 3: addQuizNodeScores();
  case 4: changeQuizNodeScores();
  case 5: createNode()
  case 6: removeNodefromELP();

return nodesInELP;

}

removeELP(elpid) {
 remove this elp;
}

createNode() {
 createNewNode();
 case authorchoice of NodeeditActions
  case 1: addLOtoNode();
  case 2: removeLOfromNode();

 return node;
}

removeNode(nodeid) {
 remove this node;
}
```

Data Structure

The run-time environment variables will be allocated in dynamic memory to complete ELP transactions.
The LAP record is loaded onto the memory prior to this calculation. The ELP uses the LAP record every time a user completes pre-assessments or starts up a new session, so it caches the LAP values hence avoiding expensive database transactions to achieve this. The adaptive algorithm then executes to adapt ELP transformations, if any occur.

Third Party Package Description - *Complete this section to describe any third party packages.*

Struts framework APIs.

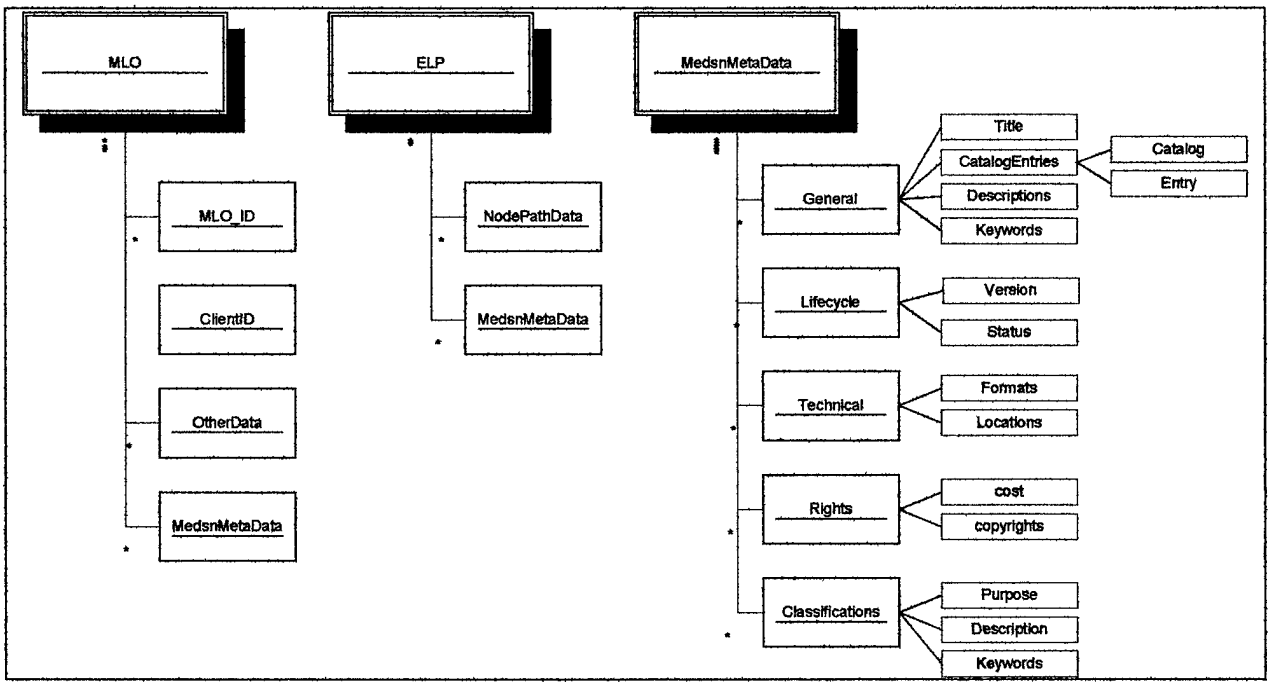
Struts uses a special Java Servlet as a server-based switchboard to route requests from web browsers to the appropriate Java Server Pages (JSPs). This framework provides a robust and rapid development framework in which to deploy Web-based applications.

SCORM Implementation

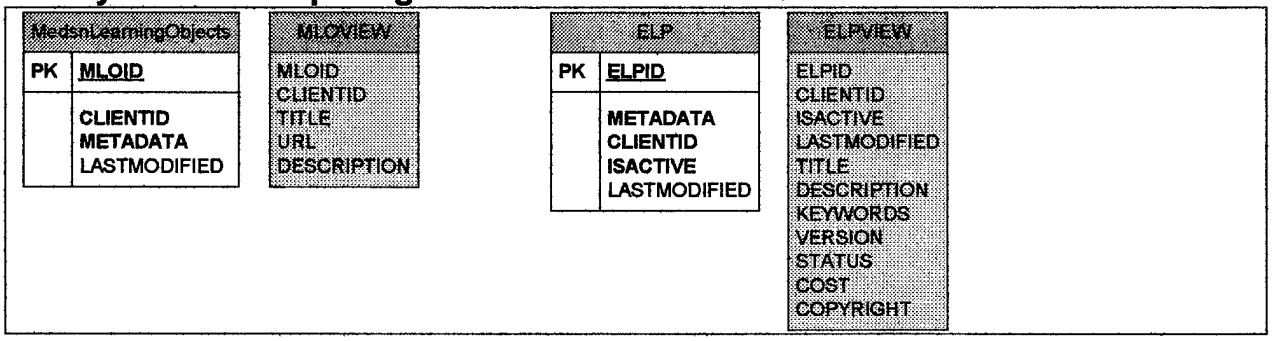
Architecture Overview

Description, purpose, objectives	Covers SCORM requirements for SCO metadata, content aggregation metadata, and the associated authoring and rendering tools.
Use Cases Included	Authoring LO metadata. Authoring ELP metadata. Exporting a course to a SCORM content package (xml).
Dependencies	The contents/target of an LO must exist before an LO can be authored.

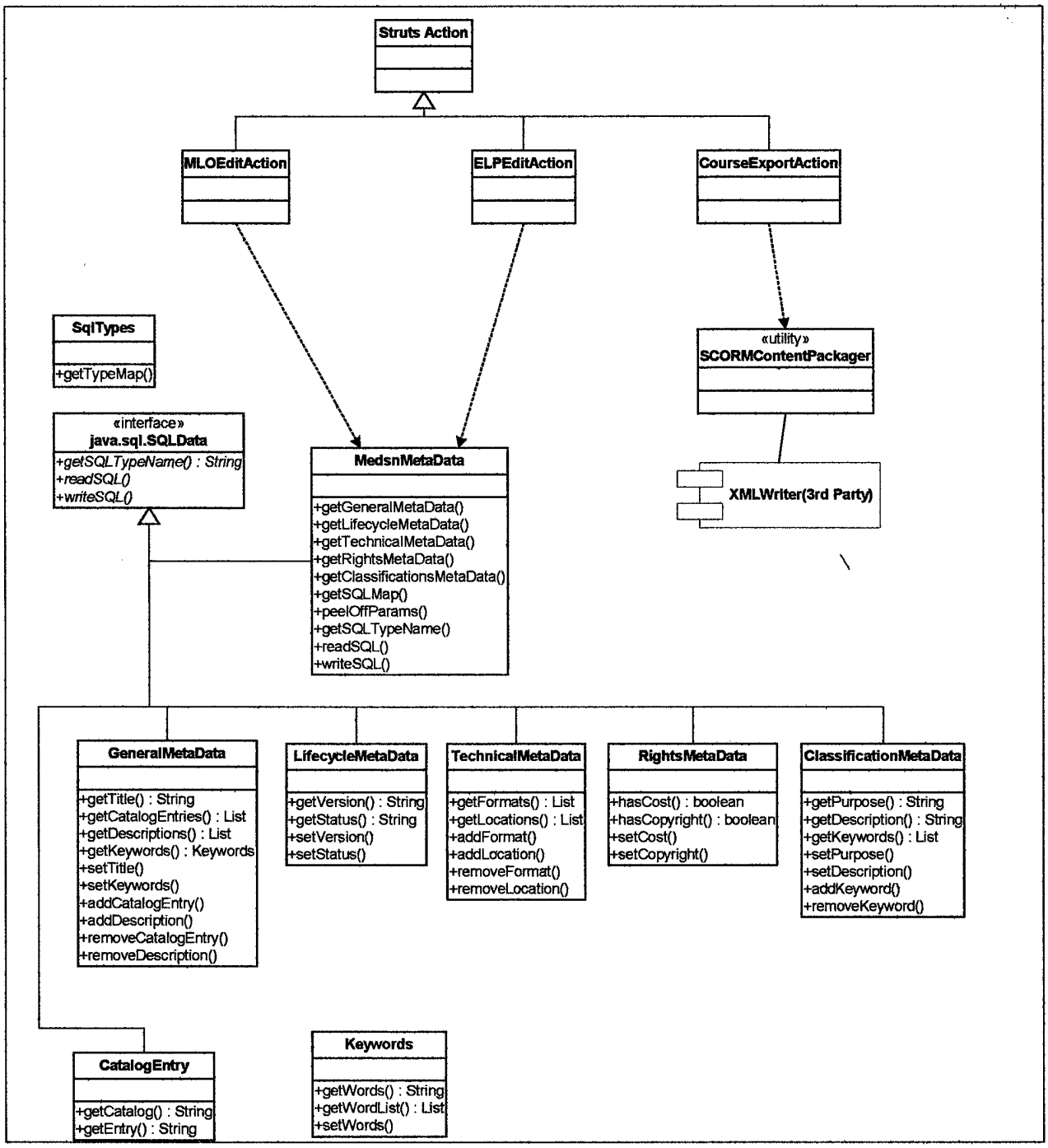
Domain Diagram



Entity-Relationship Diagram - *Describe the database architecture.*

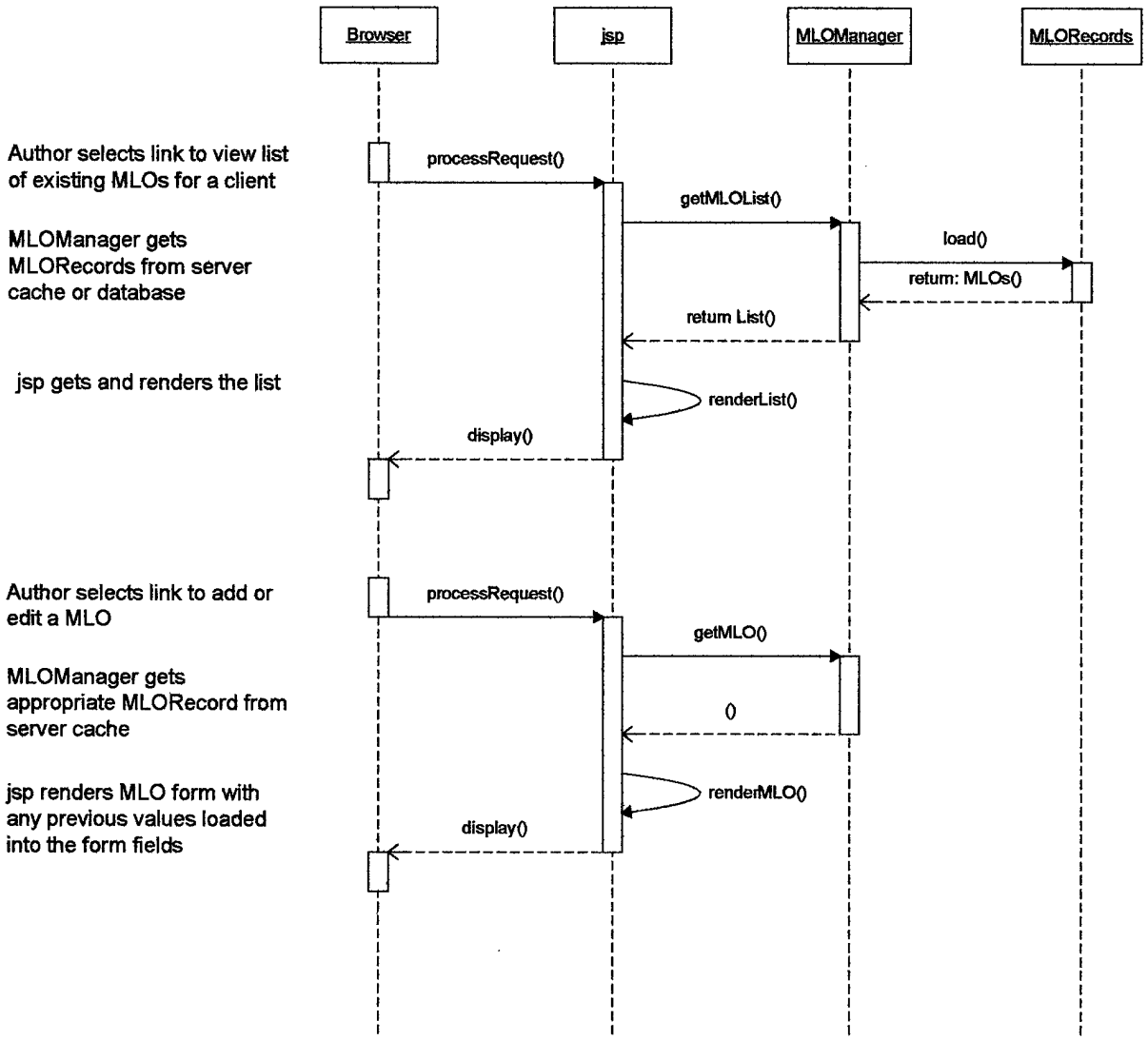


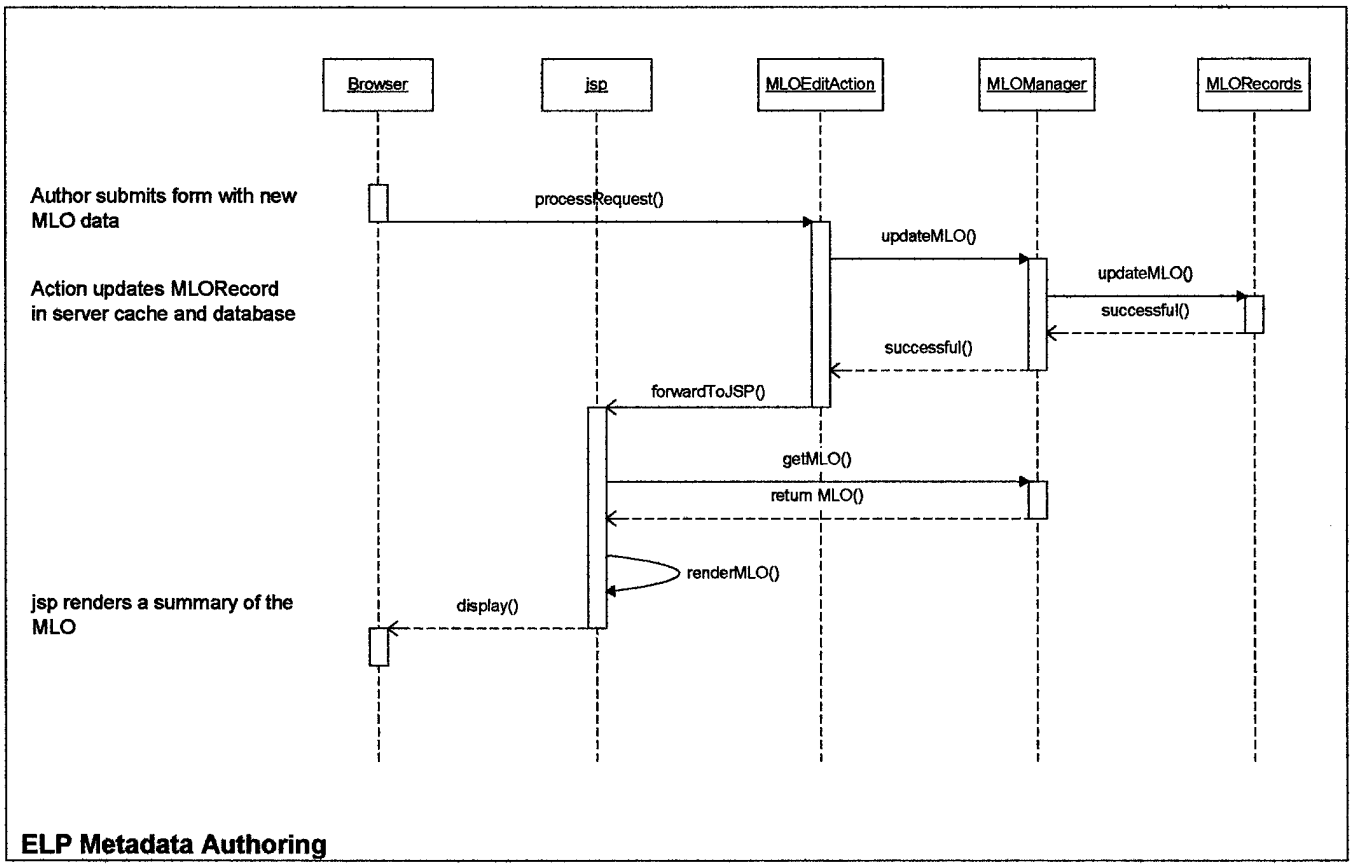
Class Diagram – *Describe all objects of the software architecture.*



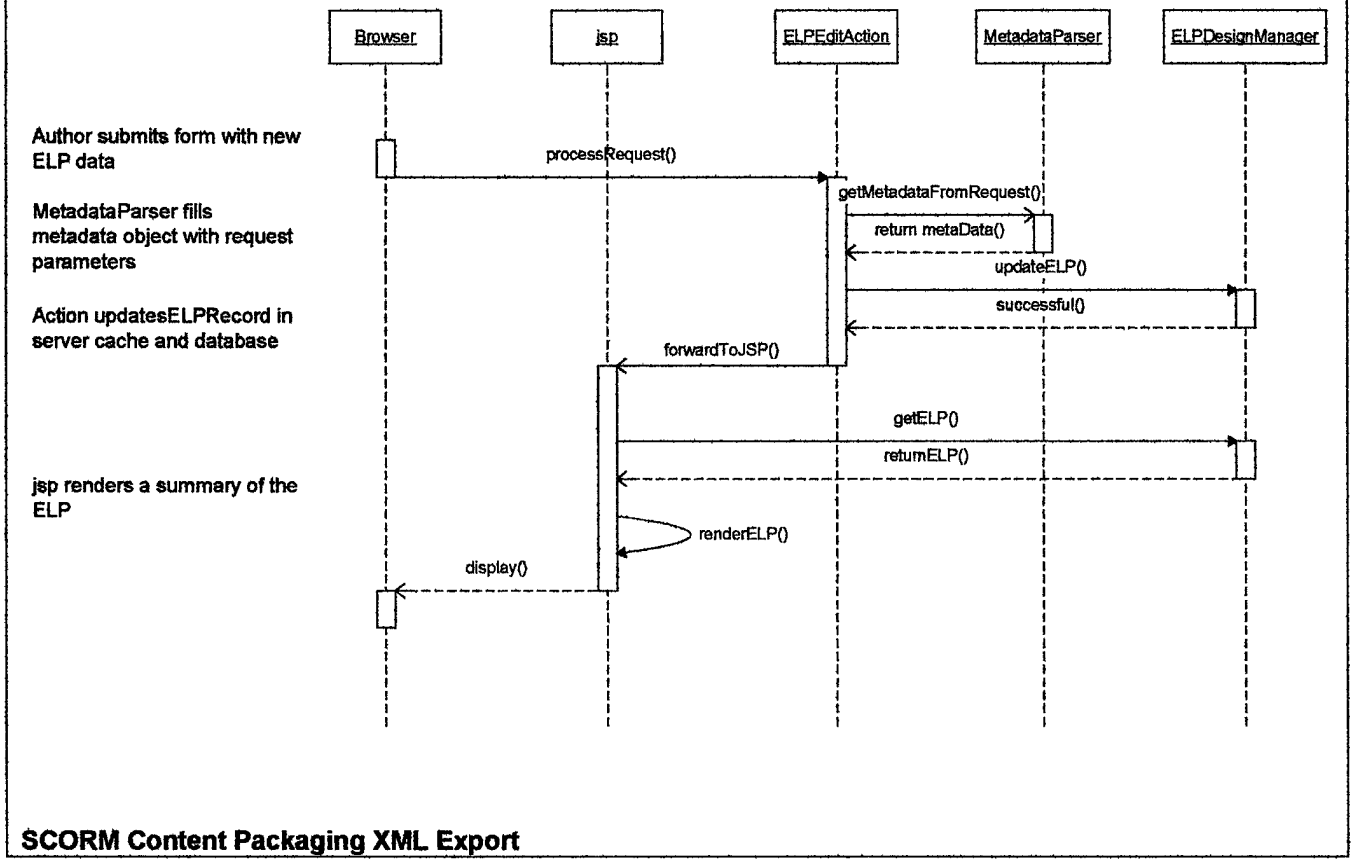
Control Flow Diagram - *Complete this section to show the control flow and the data flow of the key components or objects of the architecture.*

MLO Authoring

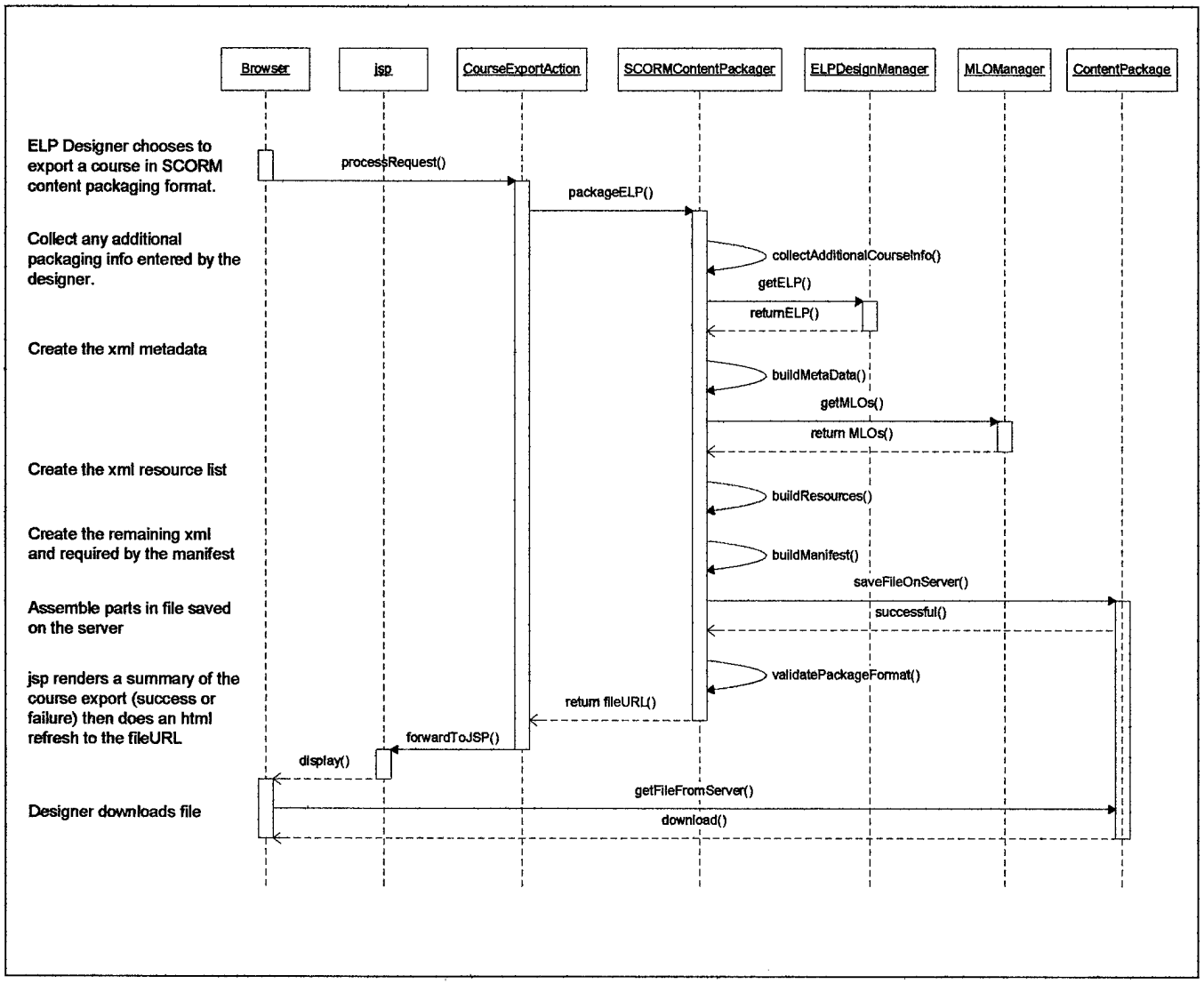




ELP Metadata Authoring



SCORM Content Packaging XML Export


Browser
jsp
CourseExportAction
SCORMContentPackager
ELPDesignManager
MLOManager
ContentPackage
ELP Designer chooses to export a course in SCORM content packaging format.
processRequest()
packageELP()
Collect any additional packaging info entered by the designer.
collectAdditionalCourseInfo()
getELP()
returnELP()
Create the xml metadata
buildMetaData()
getMLOs()
return MLOs()
Create the xml resource list
buildResources()
Create the remaining xml and required by the manifest
buildManifest()
saveFileOnServer()
Assemble parts in file saved on the server
successful()
validatePackageFormat()
jsp renders a summary of the course export (success or failure) then does an html refresh to the fileURL
return fileURL()
forwardToJSP()
display()
getFileFromServer()
Designer downloads file
download()

Data Structure - *Complete this section to describe the data structure.*

Oracle Abstract DataTypes. Format: column name (datatype)

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METADATA (METADATA_TY)
        GENERAL (GENERAL_TY)
                TITLE (VARCHAR2(1000))
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                        CATALOGENTRY (CATALOGENTRY_TY)
                                CATALOG( VARCHAR2(1000))
                                ENTRY( VARCHAR2(1000))
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                KEYWORDS(VARCHAR2(1000))
        LIFECYCLE (LIFECYCLE_TY)
                VERSION (VARCHAR2(50))
                STATUS (VARCHAR2(50)) (Draft/Final/Revised/Unavailable)
        TECHNICAL (TECHNICAL_TY)
                FORMATS(FORMATS_VA(40))
                        FORMAT (VARCHAR2(500))
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                        LOCATION (VARCHAR2(1000))
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                COST(VARCHAR2(10)) yes/no
                COPYRIGHTS(VARCHAR2(10)) yes/no
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                CLASSIFICATION (CLASSIFICATION_TY)
                        PURPOSE (VARCHAR2(50))
                                Discipline/Idea/Prerequisite/Educational Objective/Accessibility Restrictions/
                                Educational Level/Skill Level/Security Level
                        DESCRIPTION (VARCHAR2(2000))
                        KEYWORDS (VARCHAR2(1000))
```

Third Party Package Description - *Complete this section to describe any third party packages.*

JDOM xml writer. JDOM is an open-source Java package for manipulating XML documents. It provides a clear class-driven API for reading, writing, and manipulating XML documents.

Technical Data - FFP - Commercialization Metrics Report
IAW CDRL AOO3
Item No: 001AL

Contract #: USZA-22-01-C-0024
Grant #: OSD00-CR09 Phase II

Implementing Adaptive Technology and Supplemental Curriculum for Anatomy and Physiology

1. Market Summary

1.1. The Case For E-learning

E-learning is fundamentally changing the rules and modalities of education and training. Globally, organizations are challenged to continually enhance the knowledge and competencies of their employees, and traditional models have given way to Web-based education initiatives. An organization must always strive to stay ahead of its competition with innovative communication and education that is effective, fast, and efficient for all stakeholders, including employees, sales representatives, partners, customers, consumers, and local communities. E-learning's adoption rate is rapidly accelerating: In 1999, the United States spent $17 billion on outsourced training, $1.1 billion of which was spent on e-learning solutions. International Data Corporation (IDC) predicts that by 2004 e-learning expenditures will grow to $14.5 billion in the United States and $23 billion globally.

1.2. Education in the Healthcare Space

In today's information-based economy, pharmaceutical, medical device, biotechnology companies, hospitals and other healthcare organizations are exploiting the Internet and its enabling technologies to reduce costs, achieve efficiencies, and create additional value for employee training and education, and maximize market potential and sales. One of these Internet-enabled areas is e-learning.

Any pharmaceutical or medical device brand manager seeking to accelerate product launches globally cannot afford to rely only on traditional classroom-based training, be it for developing basic competencies in anatomy and physiology or for product training and positioning as part of a new drug launch or new indication. The pitfalls of traditional training include physical and geographical limitations, outdated and inconsistent information, scheduling and delivery delays, and escalating costs (both travel- and opportunity-related). These issues make for a compelling return on investment justification for e-learning: It is the most cost-effective, convenient, consistent, compelling, and the speediest method of knowledge transfer, deliverable when and where sales representatives need it.

Non-physician healthcare professionals and healthcare students–nurses, EMTs, physician therapists, and healthcare technicians–have a desire and need for personal and professional development. In addition to a broad knowledge base in science and medicine, they also have a critical need to develop their understanding of disease treatment and prevention, and prepare them for the changes occurring in healthcare delivery and managed care and the impact that these changes will have on their professions.

There are two broad end-user audiences that Medsn targets with its catalog offerings:

- Sales force training

- New hire training
- Drug launch training
- New indication training

- Non-physician healthcare professionals and healthcare students
  - Nurses
  - EMTs
  - Physical therapists
  - Healthcare technicians (i.e., respiratory, radiology, etc.)

For example, new hire training may include Medsn courseware on Foundational Anatomy and Physiology followed by one or more Organ Systems related to the company's key therapeutic areas. The experienced sales reps will typically need training on a single Organ System. Medsn will sell the content for both new sales reps and veteran sales reps, along with other customized training, while the Anatomy and Physiology training will always be bundled as a custom solution as is being done successfully today.

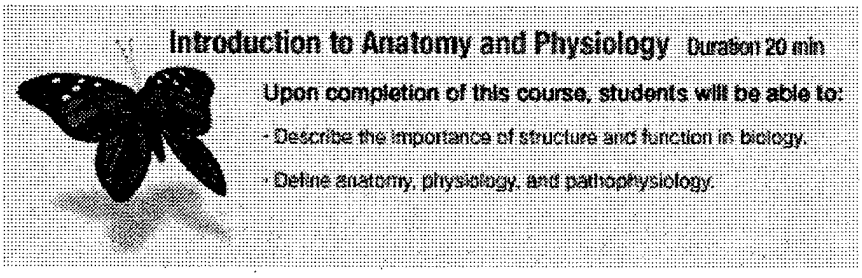
Medsn technological capabilities, developed as part of the SBIR grant, address customers' needs for customized learning solutions and successful implementation of e-learning, with the added advantage of being provide by a single vendor that can offer both content and technological capabilities.

2. Product Definition

Medsn has created a comprehensive library of 15 hours of computer-based courseware to revolutionize anatomy and physiology training for the non-clinician. Mastery of core anatomy and physiology concepts is an essential prerequisite for all disease and therapeutic training. By offering these courses in both a web-based and CD-ROM environment, Medsn provides pharmaceutical, biotech, and medical device companies, hospitals, and healthcare organizations with an accessible and affordable foundational training alternative.

Created for and used by pharmaceutical sales reps, nurses, EMTs and other non-physician healthcare professionals, these anatomy and physiology modules contain an appropriate mix of rich text, synchronized audio, compelling graphics, high-impact medical images, and Flash-based animations to create an engaging learning experience.

The courses listed below are organized by foundation topics and organ systems. Whether online or on CD-ROM, the courses can be incorporated into larger programs, such as drug launch training, or they can stand on their own as basic training.

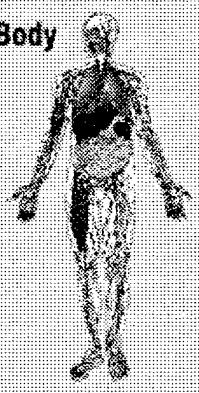


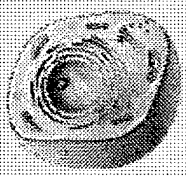
Organization of the Body

Duration 70 min

Upon completion of this course, students will be able to:

- Identify and describe the levels of organization of the body from the simplest to the most complex.
- Use anatomical terminology to describe anatomical positions, directions, and sections.
- Identify the organ systems of the human body and list the major components and primary functions of each system.
- Review body cavities and their major organs.





Cells

Duration 60 min

Upon completion of this course, students will be able to:

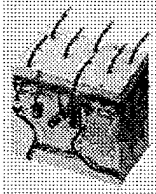
- Describe cell theory and identify the structures of the cell and its primary functions.
- Define permeability and discuss the mechanisms involved in the movement of substances across the cell membrane.
- Define homeostasis and describe the mechanisms involved in homeostatic regulation.
- Define metabolism, catabolism, and anabolism.
- Discuss carbohydrate metabolism.

Tissues

Duration 30 min

Upon completion of this course, students will be able to:

- Identify the four major tissue types and their roles.



Integumentary System

Duration 20 min

Upon completion of this course, students will be able to:

- Describe the functions of the integumentary system.
- Describe the main structural features of the skin.

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Culver City, CA 90232

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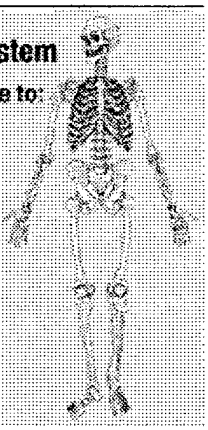
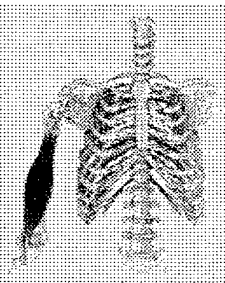
Skeletal System — Duration 30 min



Upon completion of this course, students will be able to:

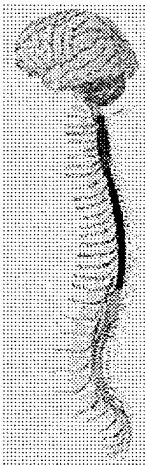
- Describe the functions of the skeletal system.
- Identify the components and functions of the axial and appendicular skeletons.
- Explain how bones are classified.
- Explain how joints are classified.



Muscular System — Duration 30 min

Upon completion of this course, students will be able to:

- Describe the general properties and functions of muscles.
- Identify the three types of muscle.
- Compare and contrast the structure and function of muscle types.



Nervous System — Duration 90 min

Upon completion of this course, students will be able to:

- State the functions of the nervous system.
- Name the major divisions of the nervous system.
- Compare the structure and function of neurons and neuroglia.
- Describe the major types of neurons.
- Understand the resting membrane potential of neurons.
- Describe how impulses (action potentials) are transmitted.
- Describe the elements of synaptic communication.
- Identify the components of the central nervous system.
- Describe the functions of the meninges and cerebrospinal fluid.
- Identify and describe the functions of the major regions of the brain.
- Discuss the structure and function of the spinal cord.
- Identify the components of the peripheral nervous system.
- Discuss the divisions and functions of the autonomic nervous system.
- Describe the relationship between the sympathetic and parasympathetic divisions of the autonomic nervous system.

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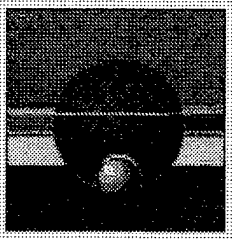
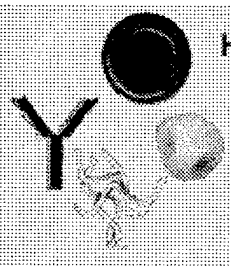
Endocrine System — Duration 45 min

Upon completion of this course, students will be able to:

- Describe the functions of the endocrine system.
- Compare the functions of the endocrine and nervous systems.
- Describe the structure of hormones and the general mechanisms of hormonal action.
- Discuss the regulatory processes of hormonal secretion.





Hematology — Duration 45 min

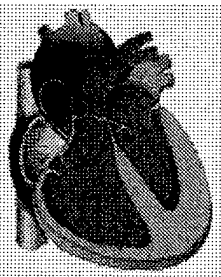
Upon completion of this course, students will be able to:

- State the functions of blood.
- Identify the components of blood.
- Describe the production of the formed elements of the blood..
- Discuss the components and functions of plasma.
- Describe the functions of red blood cells, white blood cells, and platelets.
- List the phases of hemostasis.
- Explain the clotting process.

Cardiac System — Duration 120 min

Upon completion of this course, students will be able to:

- Describe the location of the heart.
- Describe the function of the pericardium.
- Identify the major vessels and chambers of the heart and describe the flow of blood through the heart.
- Identify the major valves of the heart and describe their functions.
- Describe the heart wall and explain the purpose of coronary circulation.
- Identify the events of the cardiac cycle.
- Describe the relationship between cardiac structures and their role in the cardiac cycle.
- Relate heart sounds to the events of the cardiac cycle.
- Describe the types of cardiac muscle cells.
- Identify the parts of the cardiac conduction pathway and their functions.
- Discuss cardiac conduction and its relationship to an electrocardiogram (ECG).



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